UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

GENERAL

E/ESCAP/NR.8/16
2 September 1981

ORIGINAL: ENGLISH

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Committee on Natural Resources

Eighth session
27 October-2 November 1981
Bangkok

OIL IMPORTING ESCAP DEVELOPING COUNTRIES ENERGY SUPPLY TRANSITION SCENARIOS, 1985-1995

(Item 5(b) of the provisional agenda)

Note by the secretariat

		Page
Introduction		1
I.	The "maximum growth" regional energy scenario until 1995	6
II.	The maximum nuclear (and large hydro) scenario	12
III.	The maximum solar/wind scenario	15
IV.	Policy alternatives and recommendations	17
V.	Implementation and organizational requirements	21
VI.	Towards an ESCAP energy organization	34

Figures

1.	Oil Conservation Commission: central organization set-up	28
2.	Oil Conservation Commission: regional-level set-up	29

INTRODUCTION

1. Some of the important aspects of the demand management problem of energy transition in developing countries are the following.

2. In many developing countries, oil consumption is likely to increase faster than the growth of GDP or industrial output if conscious efforts of demand management are not undertaken.

3. The various measures considered for demand management may be classified into three categories: conservation, interfactor substitution and interfuel substitution. Conservation refers to a reduction in consumption of energy (or a particular fuel) which is the result of a reduction in the economic activity using energy. Interfactor substitution covers all those efforts where inputs (capital, skilled labour etc.) other than energy are used as substitutes for energy. The third category of measures involve interfuel substitution where the emphasis is on substituting one form of energy (e.g. oil) by another form of energy such as coal, natural gas, biogas, and electricity. It is important to make this distinction among various types of measures because each of them has different implications in terms of requirements of scarce inputs such as capital, foreign exchange, skilled labour and management. Besides, relative prices of inputs other than energy become crucial determinants of the financial viability and acceptance of different measures.

4. A given strategy of demand management involving a mix of conservation, interfactor substitution and interfuel substitution may use pricing mechanism or non-price measures as instruments. The effectiveness of a given strategy would depend on the response it receives from millions of consumers: households, farmers, entrepreneurs, managers, transport operators and others. One of the ways of measuring consumer response to changes in price is to use past data to estimate price elasticity of demand and elasticity coefficients for interfactor and interfuel substitution. Reliable estimates for price elasticity coefficients for oil products in developing countries are not available. However, the available estimates for own-price elasticity in developed countries show that oil demand is responsive to changes in prices and there is considerable scope for interfuel substitution in various sectors. Available evidence for India's industrial sector also shows that capital as well as labour can be substituted for energy in various units.

5. Experience of the effects of the rise in oil prices in four south Asian countries - Bangladesh, India, Pakistan and Sri Lanka - shows that the restraint in oil consumption was due to slower or no growth in oil-dependent activities rather than to interfuel substitution. However, in India, there was evidence of reduction in oil input per unit of output in major oil-using industries which could be considered a result of price increases and rationing of furnace oil.

6. Estimates of potential savings in the consumption of commercial energy and/or oil products made by the World Bank and other agencies show that reductions ranging between 15 to 25 per cent are possible within 10-15 years if adequate measures are undertaken to encourage conservation, interfuel substitution and interfactor substitution.

7. Strategies of demand management could be designed (a) to reduce the over-all demand for energy and (b) to influence the fuel-mix in favour of energy sources other than oil. The choice of development strategy of a country would depend on a variety of historical, political, economic and social factors. Since energy costs and availabilities may be a major potential constraint on development, it is essential that energy implications of alternative strategies should be explicitly analysed and considered in development plans. Although energy aspects may not determine the development strategy, energy considerations may be highly relevant to specific choices connected with urbanization, location of industries, modes of production, mix of products etc.

8. Strategies aimed at influencing input-mix would require substitution of oil by other inputs (capital, foreign exchange, skilled labour) and/or other energy sources (coal, natural gas, renewables). Such possibilities exist in almost all end-use sectors. For example, in transportation, a heavy oil-user, a shift from road transport to railways would improve the efficiency of energy use while electrification would further reduce diesel consumption on railways. However, such substitutions would require high capital investment and are likely to reduce employment. A detailed consideration of similar trade-offs may be required in industries, irrigation pumping, household uses for lighting/cooking etc.

9. The strategies of oil conservation would require adjustments in pricing policies as well as use of non-price instruments. In the case of prices, it is necessary not only to consider relative prices of different fuels but to

/also consider

also consider prices of capital and labour relative to energy prices. It is necessary that prices of different fuels and/or energy products be determined in an integrated framework.

10. The success of price policy in achieving the desired objectives of conservation and interfuel substitution depends on the special characteristics of energy demand in developing countries. The level and pattern of energy consumption in these countries is determined more by supply constraints than by demand considerations. Non-availability of relatively cheaper fuels may be on account of lack of production capacity or transport bottlenecks or both. In such situations consumers would have to adjust their demand patterns to availabilities of different fuels even if their economic and technical preference may suggest a different fuel-mix. User choices may be affected by factors other than the relative prices of fuels (adjusted for efficiency differences), e.g. security of supply, uniformity of quality and the effect of fuel-mix on the quality of processed materials. Besides, fuel costs form a small proportion of total costs in many industries in developing countries and entrepreneurs are in a position to pass on the increases in fuel costs to the consumers because of protected markets, lack of internal competition and general shortages of goods and transport capacity.

11. In many developing countries the existing prices of capital, labour and foreign exchange may not necessarily reflect their "true opportunity costs" due to market imperfections and/or administrative controls (minimum wages, subsidized capital, import quotas etc.). Given the distortions in prices of non-energy inputs (whether justified or not) it may be necessary to fix energy prices in such a way that they do not provide wrong signals to the consumers resulting in substitution of these scarce inputs for energy.

12. Non-price instruments include rationing of fuels, direct regulations on consumers or on producers regarding car use, energy-using equipment etc. The efficacy of these instruments would vary from one country to the other depending on the use of private cars, machinery for implementation of government legislation and the extent to which Government can control the activities of a large number of producers. The use of extreme step of rationing may be required in situations of temporary shortages but is not likely to be effective as a long-term policy instrument.

13. The experience of conservation and interfuel substitution in some developing countries in the last decade or so has suggested that the success

/of various

of various policy instruments depends, to a large extent, on the organizational support that is provided for policy implementation. Since a large number of consumers including households, entrepreneurs, managers, transport operators etc. are involved in decisions regarding oil conservation it becomes necessary that the consumer is made aware of the existence and financial viability of a variety of measures/technologies for fuel conservation. The consumer has to be convinced that these measures are in fact effective and these technologies are available and they would show the performance as is claimed for them. Besides there may be need to provide incentives in terms of some form of subsidies, tax concession, soft loans etc. so that consumers are in a position to implement such choices. It is necessary to provide various services as a package which would consist of (a) availability and knowledge of technological choices, (b) economic evaluation of technical alternatives, (c) financial viability and motivation and (d) organization and management involving delivery of services.

14. On account of significant differences among ESCAP countries in regard to size and role of government it is difficult to suggest a prototype organizational structure for oil-conservation programmes. For a large country with substantial control by the Government, there may be need to have one central organization and a number of regional/State level organizations. At the centre the organization may be divided into three functional divisions: technical and environmental division; economic and financial division and administrative division. These divisions would work in close co-operation among themselves as well as with other government agencies in order to provide necessary services to the consumers. A "package approach" would be required under which the administrative agencies would provide consultancy services, equipment and installation as well as after-sale-services to the consumers. It would also include assistance in securing necessary finances for consumers, raw materials for manufacturers and spare parts for consumers/manufacturers.

15. The administrative organizations at the regional levels would also provide similar services to small industries, agriculture and rural households. Provision of such services would require support of the local administrative and political organization as well as that of local trading and financial institutions. It is considered that an efficient organizational set-up staffed by expert manpower is a necessary condition for the successful implementation of the programmes of oil conservation and adoption of renewable energy sources in developing countries. The organizational structure, most suited to each individual country would have to be evolved by keeping in mind a variety of political and economic factors. A beginning may, however, be made to conducting a comparative study of different organizational structures in a few selected ESCAP countries.

16. The questions this study seeks to answer are simple ones: what is the maximum deficit in energy the ESCAP region is likely to face in the next 10 to 15 years? How can these deficits be managed? It does not address the problem of how the indigenous energy resources are to be developed, it only sketches the outline of some archetypal alternative supply transition scenarios, assuming that for a successful growth process energy needs would have to be met in some way.

17. To estimate maximum energy requirements, models based on previous "cheap energy" periods are likely to give the maximum requirements. Thus, the basis of our forecasts are World Bank projections based on econometric studies of pre-1973 growth of energy consumption figures.

18. Similarly, the maximum imported commercial energy requirement would arise if energy could be made available without the balance of payments constraints which might, in the real world of high-priced energy, restrict imports. To identify the size of the energy problem, one thus uses naive projections of both indigenous and imported energy supplies, and then argues for plansible ways in which these could be met. In the alternative scenarios one also argues that a maximum electricity development scenario (whether centralized large power systems or distributed, small, local units) will reduce the total energy required on account of the versatility of end use of electric power (not usually taken into account in energy balance calculations). The argument is made for liquid fuel needs to be met from conventional (oil, gas, coal) resources in the foreseeable future, with a gradual introduction of biomass-derived fuels.

19. The scenarios supplied below are descriptive in nature, indicating the size of the problem on the one hand, while on the other, the areas where more information is necessary in order to be able to arrive at policy decisions. Such information could be provided by the proposed, amended, ESCAP work programme.

20. In the final section recommendations both for managing the transition to new and renewable sources of energy at the national level, and also for the "technical fix" described in these scenarios for the management of possible oil deficits at the ESCAP regional level are presented. It is argued that only if the political will exists to organize and manage the transition at both levels will the process be succesful.

I. "MAXIMUM GROWTH" REGIONAL ENERGY SCENARIO UNTIL 1995

21. Taking the World Bank's economic growth forecasts as a basis the demand for energy of the oil-importing developing ESCAP countries has been projected. These countries have been selected because, the developed member countries of ESCAP and the energy exporting countries in the region could satisfy total demand regionally if necessary (e.g. Iran, could cover Japan's needs etc.) even if present trade patterns are not restricted to intra-regional trade. The oil-importing developing ESCAP countries are the ones facing the most severe problems.

22. There was a net export of energy from the ESCAP region (79.46 mtce in 1975 and 124.62 mtce in 1976) and the aim is to preserve this level of net reported exports in making forecasts, considering exports to grow together with energy "demand", in terms of needed export earnings generated for the region.

23. On the basis of a study by Choe[1/] and assuming that:

(a) ESCAP oil-importing developing countries will keep the same share of all developing countries' energy demand during the forecast period;

(b) The proportion of imports in total consumption will remain the same as at the base period.

24. The forecast energy demand and its composition for ESCAP oil-importing developing countries can be tabulated, based on Choe's regression results. Note that these regression results assume that all energy needed for growth will be obtained.

Table 1. Energy demand: mboe/d

	1975 (base)	1985	1995
Oil-importing developing ESCAP countries[a/]			
Total consumption[a/]	3.6	6.3-6.5	10.8-11.5[b/]
from imports	1.17	2.0-2.1	3.5-3.8
from indigenous production	2.43	4.3-4.4	7.3-7.7
All ESCAP countries			
Net exports	1.118	2.0-2.3	3.4-3.7

Notes: a/ Including India, the Philippines, Republic of Korea, Thailand with a total of 760 000 b/d 1975 imports and other importers with a combined total of 412 000 b/d

Excluding Australia, Japan, New Zealand (developed countries) and net energy exporters (Afghanistan, Brunei, Burma, China, Indonesia, Iran, Malaysia)

b/ Using growth rates assumed by A.D. Melchor (ADB), 1985 and 1995 figures would be 5.9 and 9.5 mboe/d.

1/ B.J. Choe: "Energy demand prospects in non-OPEC developing countries", IEA Workshop on Energy Supply and Demand, OECD, Paris, 1978.

25. Note that in table 1 the forecasts for imports could be considered high in the sense that:

(a) The proportion of indigenous energy in total demand is likely to increase, not staying constant due to successful import substitution;

(b) Some shift away from "energy-intensive" industries is likely, even if the requirements of economic growth-related structural changes (e.g. urbanization, industrialization) are likely to keep total energy demand high. The wish is to investigate the maximum possible energy problem, in order to see whether it is manageable.

26. Scrutinizing these numbers, it is seen that as long as indigenous energy growth can be achieved, the part that is traded is likely to stay in balance, in the sense that the increase in energy exports (mainly coal from Australia) could balance the increase in needed imports (as long as importers can switch from oil to coal).

27. There are a few salient features of the above ESCAP energy situation which deserve emphasizing:

(a) ESCAP is (and for the next 10-15 years is likely to remain) self-sufficient in commercial energy (inspite of the fact that two thirds of the members are deficient);

(b) Because of this, the drastic oil price rises since 1973 have not slowed down economic growth in the developing ESCAP economies to the extent anticipated;

(c) Ability to cope with oil price rises is aided by the ability of the region to attract investment capital on the one hand, and by capital formation due to indigenous oil production (and export) on the other in some ESCAP countries (e.g. Brunei, China, Indonesia, Iran, Malaysia).

28. Because of these features, the ESCAP region has a better chance of managing a fairly smooth "energy transition" in the next 10-15 years than many other, possibly less fortunate, regions. There is a discussion below of what might be considered to be a "natural" way of managing such a transition, taking existing trends and recommended policy measures into consideration.

/Supply

Supply considerations

29. Is the above "surprise free" scenario possible in terms of available regional supplies? After all, the high line is equivalent to additing another Japan to the region in terms of energy requirements.

30. Looking at the disaggregated figures however, the problem appears to be manageable. As noted before, exports from the region just about match Australia's proposed increase of coal export capability (to some 100 mtce by 1990 and 200 mtce by 2000). If this would be used in the region instead of exported to Europe, then import requirements would vanish. However, this would mean a switch to a "coal economy" for any additional import demand. Growth of indigenous production of the order of magnitude envisaged does not seem inordinately large, remembering that the above oil-importing developing ESCAP countries include India. It would mean some 80 1000-MW new hydro or nuclear plants by 1985 and another 100 by 1995.

31. Although plans for the period up to 1985 include only about half the projected indigenous energy supply increases in terms of known additions to power plants, it is not unreasonable to expect that increases in coal, lignite, oil, gas and fuelwood could cover the rest of projected indigenous energy use.

32. As far as the 1995 supply situation is concerned, if all the hydro potential as shown in a recent alectricity survey is developed, there is some chance of achieving the indigenous growth targets mentioned above. Alternatively nuclear additions to base-load supply might be required.

Balancing supply and demand

33. One of the ways of balancing supply and demand is to use Australian coal. At the identified import requirements level (0.8-0.93 mboe/d in 1985, 1.5 to 1.7 mboe/d in 1995) the effect of a few large gas projects might also be considered as a means of meeting part of the above import demand. Since some of the demand originates from the scattered island countries, a coal- or oil-based system would always be required for the small parcels these islands can take (as opposed to the comparatively large volumes obtainable from a LNG project suitable only for comparatively large countries). Biomass-derived ethanol/methanol quantities could be identified which could replace requirements for - mainly - transport fuel for the smaller countries.

/34.

34. The above considerations assumed that indigenous hydrocarbon production in the region would at least stay at current levels. This is a justifiable assumption until 1985. However it becomes tenuous if our extends the time horizon until 1995. The reason is that the geological structures of the existing oilfields in the South China Sea area (Brunei, China, Malaysia and the Philippines as well as, to a certain extent, Indonesia) are such that with current production practices, existing oil fields are likely to decline to about half their current production levels by 1995. New discoveries could, of course, replace existing fields, but for this an exploration success ratio larger than recent levels would have to materialize. It is, thus, the more necessary to consider coal, gas and biomass projects to replace perhaps an additional 1 million barrels per day hydrocarbon supply which might be lost from existing supply levels from existing fields.

35. To put the above magnitudes in perspective, it is worthwhile to remember that a VLCC (very large crude carrier) of about 200,000 dwt (dead weight tons, measuring water displacement, thus possible load) carries about a million and a half barrels of oil. Thus two supertankers every three days from the Middle East could easily satisfy the above shortfall. The difficulty is that by the early 1990s there could be intense competition for Middle East crude, thus it is politically-difficult to ensure that such supplies would indeed be forthcoming. At the same time, the Middle East countries are anxious to market their associated gas, at present still mainly flared. Thus long-term LNG or methanol export projects negotiated now for the 1990s might well be possible. It would take only about three Malaysian sized LNG projects to cover the above possible shortfall. Thus, it would be advisable for the ESCAP region to investigate such possibilities now, since such projects have a lead time of about ten years. Capital costs are large. However, for these types of investment, Middle East commercial/finance capital is likely to be available (the order of magnitude could be some $US 10 billion) due to the fact that it is the kind of business oil producers feel comfortable with, and it is likely to be profitable. The Philippines, the Republic of Korea and, perhaps, Thailand might be likely candidates - the latter, perhaps, only for liquid fuels such as methanol or LPG.

Coal

36. The pertinent features of coal availability are that there are large resources in the region (Australia, China, India, Indonesia) and that there are large expansion plans for export capacity (Australia).

37. Since the economics of seaborne coal transport is such that costs per heating value delivered are much higher than for oil (e.g. say, $US 3.50 per ton of coal equivalent heating value in oil delivered from the Middle East to Japan and at the same time, some $US 10-15 for a ton of coal delivered from Australia to Japan, depending, of course, on average tanker rates, sizes, and average dry-bulk time charter rates and sizes used in the trade), it is likely that Australian coal will have to find its markets in the ESCAP region rather than in Europe. Although coal-fired ships would represent a ceiling on the fuel costs of such transport, the existing stock of ships is almost all diesel/fuel-oil fired. Thus the above economics of coal transport is likely to get worse in the next 10-15 years (until existing ships are, perhaps, replaced by coal-fired coal carriers) as a result of the expected rise in oil bunker prices.

38. There are several effects which render the shipment of oil cheaper than shipping coal. First, assume the same ship, say a 150,000 dwt obo (dead weight ton oil/bulk-ore carrier), capable of carrying a cargo of some 140,000 tons of oil or the same amount of coal. Since, on average 1 ton of oil has the equivalent heating value of 1.5 tons of coal, assuming the same distance (e.g.: the Gulf - Japan, roughly equivalent to Australia-Japan) there would already be a 50 per cent cost advantage per delivered heating value of oil, assuming the same loading and discharging rates.

39. Additional factors, among others, are that the oil trade uses VLCCs, (200,000 dwt and larger ships) while port limitations at present would restrict the coal trade to about 150,000 dwt ships. Thus another 50 per cent cost advantage of delivered oil would result from economies of scale given also that the VLCC market is more depressed than that for small vessels. Oil carriers load and discharge in about 10 hours, giving turn-around times of about 1.5 days. Coal carriers take a week to load and another week to discharge. Thus, say, on a 30 day round trip, another 50 per cent cost advantage would result from handling efficiences of the liquid cargo.

40. The above cost advantages add up to a factor of 2 to 4 in transport cost increase per delivered calorific heating value for a coal economy, as opposed to an oil economy. (The above arguments could be used in favour of liquification of coal at producing sites, and, then, shipment of liquid fuels in tankers.)

41. In order to render the "import replacement" scenario feasible, it would be imperative to investigate the possible regional logistics of coal. Such a study recommendation is presented in the last section. A study of coal beneficiation in the region is alos required, establishing the feasibility of "coal centres"

/(or "coal-plexes"),

(or "coal-plexes"), employing the "total energy" concept for power generation, coal derived gaseous and liquid fuel and chemical feedstock.

Methanol and LNG

42. LNG technology is available and commercially viable. By its nature, it requires continuous take-off, liquification, shipping, regassification and use, thus its major market so far has been for primary (low pollutant) energy power generation applications in Japan. These projects (with an estimated 20-year lifetime each) are highly profitable for investors while, at the same time, supplying clean energy at competitive prices. The only drawback of the projects is their long lead-times because of the detailed contractual arrangements between at least two (but often several) countries, defining economic "ground rules" for a 20-year period. Becuase of this, however, these contracts could be considered to have a "stabilizing" effect on international politico-economic relations.

43. Methanol production is another way of beneficiating natural gas reserves. The World Bank estimates standard commercial methanol plants to be available at about $US 140 million capital cost, producing 3,600 mboe/d. Since these are less difficult to implement than LNG projects, methanol schemes are more likely to be able to cater to both user requirements and gas availabilities at various locations. Moreover, since methanol can be stored without refrigeration, the continuous offtake requirement of an LNG project is less likely to be a continued drawback. Methanol can be converted to gasoline. The World Bank reports that

> "Potentially one of the largest new uses of methanol is the conversion of methanol to gasoline. The New Zealand Government has decided to construct a 12,500 B/D plant at an estimated cost of $US 500-650 million; the estimated cost of the gasoline is believed to be in the range of $US 50-60 per barrel (at a crude oil price of $US 28/barrel f.o.b. the ex-refinery value of gasoline is $US 43.50/barrel. Crude prices have been kept at $ 32/barrel for Saudi Arabia's market crude, while most other crude was sold at higher prices). Other important new applications of methanol are: as chemical feedstock; an octane improver (instead of lead, which is environmentally banned in many countries) for gasoline; a kerosene or diesel oil extender; a feedstock for the production of single-cell protein (SCP, an animal-feed); and a utility fuel to meet peak power needs."

44. Moreover, a Japanese report[2/] estimates that an all-methanol internal combustion engine would be developed, combining some of the features of gasoline and diesel engines, thus possibly doing away with costly methanol gasoline

/conversion.

2/ The Alcohol Fuels from Energy Farming (Tokyo. The Institute of Energy Economics, 1980).

conversion. If that materializes, developing countries could very well cover their diesel requirements (for heavy duty machinery) via methanol. Diesel, at present, is the primary fuel used in projects related to economic development.

45. For all the above reasons, methanol import-export schemes should be seriously considered, utilizing the methanol likely to be available from the Middle East after 1985. The only drawback to methanol is its toxicity. Handling and licensing rules have been developed as methanol is a substance which has been known and used for a long time.

Biomass derived fuels

46. One of the beauties of a methanol energy economy would be that it could be phased "naturally" into renewable fuels. This is especially true of the ESCAP countries, where growth of a "seven-year cycle tropical" pine, ipil-ipil (Leucaena) and/or eucalyptus on marginal lands could serve as a ready source of wood alcohol (methanol). In a United States study,[3/] it has been estimated that if all of California's foothills (at present scantly covered with mediterranean-type shrubs) were to be planted with eucalyptus, the yield of methanol would be sufficient to fuel all of California's present stock of cars, on a renewable basis.

47. Some countries also have ethanol production potential - this, however, competes with sugar and nutrients, thus it is less likely to be available for fuel applications, except in countries such as Brazil, with abundant land resources per capita. Currently the biomass derived ethanol, methanol and methane production questions are the subject of an ESCAP secretariat study being financed by the Finnish Government.

II. THE MAXIMUM NUCLEAR (AND LARGE HYDRO) SCENARIO

48. The increase in indigenous energy production in the oil-importing ESCAP developing countries between 1975 and 1985 is some 80 GW and between 1985 and 1995, 100 GW, using OECD conversion factors. Not all of this would be electric capacity, since indigenous production of oil, coal and fuelwood are all included. The appropriate nature of the OECD conversion factor is also questioned by a French study[4/]. The argument is that electricity for final users is worth more than the strict calorific conversion of a generation plant. Thus, in fact,

/if all

3/ National Geographic Energy Issue (Washington DC. February 1981).

4/ J.R. Frisch and J. Lacoste: "Energy balances and electricity in terms of fuel equivalents with reference to OECD balances" IEA Workshop on Energy Supply and Demand, OECD, 1978.

if all energy requirements could be met by electricity, the capacity need only be about one third of the above figure - using the conversion factor recommended by the above study.

49. Since the principle of using the right conversion factor is of considerable importance, it is worth re-iterating: current accounting conventions used by the OECD underestimate the value of electricity in end-uses. The value used is 1 kWh = 0.86 Mcal, while the French study convincingly argues for 1 kWh = 2.22 Mcal as being a more correct figure, taking into account the versatility of end use (e.g.: electrolysis, motive functions, light and heat) of electric power.

50. A maximum large hydro and nuclear scenario would thus assume two things:

(a) Most of the increase in indigenous demand would be met by large-capacity electric power plants (nuclear or hydro);

(b) The end-use value of these installations could be calculated by the French study method, i.e. only about a third of the 80 GW (1975-1985) and 100 GW (1985-1995) oil equivalent capacity would, in fact, be needed. (Note that if some uses are met by directly burnt fuels, that portion not met by electricity will revert to the original, factor-of-three multiplied, requirement. The accounting method introduced here is valid only for an "all electric" society).

51. Using the one-third factor, 26.9 GW electric power till 1985 and another 33.5 GW till 1995 would be required. Taking the World Bank cost estimates of $US 1.1 billion for 1 GW hydro and $US 1.6 billion for 1 GW nuclear power plant, cost estimates based on 50 per cent nuclear, 50 per cent hydro development (consistent with the roughly 160 GW undeveloped hydro reserves in the ESCAP region would be $US 36.3 billion in 1985 and another $US 45.2 billion until 1995. What the above scenario implies is a structure of power generation and use characterized by a large base load (and "smoothed" peak) pattern of electricity demand, achieved by policy measures which would ensure an even rate of electricity use - possibly via inserting large, central, pumped storage (e.g. pumped water for hydro plant) into the system.

52. There are two excellent reviews of the economics of nuclear power in the next 20 years: one by Alan Strout[5/] discussing the likely penetration potential for developing countries and the other by John B. Gordon and Martin L. Baughman,[6/] an anlysis of the so-called "throwaway nuclear cycle" for using uranium as a

/non-renewable

5/ Alan M. Strout: "Nuclear power in developing countries", in Pyndick, Advances in the Economics of Energy Resources, vol. 1 (1979).

6/ John B. Gordon and Martin L. Baughman "Economics of the throwaway nuclear fuel cycle", Pyndick, ibid.

non-renewable resource. In addition, an excellent discussion of the fuel supply security question and expected costs of nuclear fuel in a review of Thomas L. Neff and Henry D. Jacoby[7] comes to the conclusion that although mining, enrichment and fabrication capacities are likely to keep up with demand, political considerations (e.g., the nuclear weapons proliferation question) are likely to result in some uncertainties in both availabilities and costs.

53. Alan Strout argues that nuclear expansion is likely to be the cheapest way to expand baseload electricity generation and that even if reactors smaller than 600 MW are excluded, the penetration rate into electricity generation would be 19 per cent by 1990 and 36 per cent by 2000 for developing countries with nuclear potential (in contrast, IAEA estimates, including reactors down to 200 MW, would be 37 per cent by 1990 and 59 per cent by 2000). Gordon and Baughman show that even if recycling technology is restricted (because of political, environmental or other reasons) the cost of nuclear generation, based on existing reactor technology and known uranium supplies, will give power generation costs very similar to large-scale coal/thermal generators, thus a base load nuclear programme could still go ahead to the extent of at least 300 GW added nuclear capacity. For comparison, it is worthwhile to note that the Strout report for the developing countries projects a total addition of 208.1 GW between 1990 and 2000 (from a base of 73.9 GW in 1990). 1980 nuclear generating capacity for these countries is assumed to be 34.2 GW taking the IAEA's 8 per cent growth per annum estimate.

54. It may be helpful to summarize the arguments for and against a predominantly large nuclear power plant based scenario.

(a) Arguments in favour of a "large nuclear" system:

(i) It is the "cheapest" in terms of long-term costs;

(ii) Economics of scale allow for the most economic supply of base load;

(iii) It is a clean energy source, in the sense that there is no smoke or chemical pollution;

(iv) Long-term contracts assure long-term supply security.

(b) Arguments against a "large nuclear" system:

(i) Since fuel processing and fabrication - as well as ore supply - are controlled by relatively few producers, both supply security and price questions might have similar characteristics to OPEC oil in the long run;

/(ii)

7/ Thomas L. Neff and Henry D. Jacoby: "Supply assurance in the nuclear fuel cycle" Annual Review of Energy (Palo Alto, CA), vol. 3, 1977.

(ii) Recycling of fuel and waste disposal questions have not been completely solved yet;

(iii) Hazards of nuclear weapons proliferation are associated with fuel recycling technologies;

(iv) Political opposition, in terms of "anti-nuclear lobbies", might slow down the approval of nuclear power expansion plans;

(v) The possibility of accidents (e.g., Three Mile Island) cannot be completely ruled out, even if their effects are controlled;

(vi) "Front end" capital costs are high for plant, equipment and fuel;

(vii) Stand-by capacity is also large for these large units, thus there is high cost;

(viii) Waste heat "thermal pollution" danger exists with some reactor designs.

55. Because of all the above considerations, a predominantly nuclear scenario is not judged to be very likely, although those ESCAP countries where large hydro potential is not available could very well consider nuclear plants for base-load expansion.

III. THE MAXIMUM SOLAR/WIND SCENARIO

56. On a similar "all electric" basis, the cost of the cheapest wind generators given by the World Bank would be US$ 5 billion per 1 GW capacity, provided such capacity could be made available. Assuming that solar capacity will after a while match the above cost via the "experiential curve" of manufacturing (not that at present, direct photovoltaic systems - including required energy storage - are at about four times the above cost level!), total costs for a maximum solar/wind scenario would be at least 3.7 times that of the maximum nuclear scenario, or $US 134 billion until 1985 and an additional $US 167 billion until 1995. Thus, the conclusion under the present cost regime must be that the distributed solar/wind energy systems cannot be afforded, even though for rural development and "resilience" reasons it might be thought that these are desirable. The above are essentially "economy of scale" type results, although, in a sense, one is comparing "apples with pears", since there is a chance that the solar/wind distributed system can be built with larger labour and smaller capital inputs while the capital costs of the hydro and nuclear systems are related to plant, equipment and fuel - with comparatively little

labour input. In countries with large and under-utilized rural labour forces and capital scarcity, the predominantly solar/wind scenario might still be attractive, by virtue of this "labour for capital" substitution possibility, for at least part of the energy supply developments.

57. One must also realize that (barring the large-scale utilization of pumped water or similar storage at a central, large power station already changing the character of a solar/wind system) the distributed generation of power may not match likely user demand patterns. It would correspond to a relatively small sustainable base load and a large "variable" load, where, on the one hand, users would have to accommodate themselves to patterns of availability while, on the other hand, the system would be quite "resilient" (in the sense that parts of it could be "out" without affecting the rest). To achieve similar "resilience" in the large nuclear/hydro systems, much higher stand-by capacity would be required.

58. A good discussion of system design, reliability, and performance of solar/wind versus large hydro based energy systems can be found in an article by Edward Kahn[8/]. In particular, a number of regulatory/pricing problems would have to be resolved with such a system, determining how the dispersed generating and consuming units could sell/buy electricity to/from the central grid, as well as how the economics, location and size of energy storage and its legal status could be defined for the system.

59. It may help to summarize the arguments for and against a predominantly solar/wind based energy supply development scenario.

(a) Arguments in favor of a "solar/wind" system:

(i) Rural development (via rural self-help) is a real possibility;

(ii) Possible economies of scale for components manufacture (i.e. solar cells, storage, wind generators);

(iii) Dispersed investments at the village level, with possible multiplier effects for development and growth;

(iv) "Resilience" of system (i.e. local outage does not effect others).

(b) Arguments against a "solar/wind" system:

(i) With present technologies, it is the most expensive;

(ii) Interruption of supply due to local solar/wind conditions is a "fact of life";

/(iii)

8/ E. Kahn, "The compatibility of wind and solar technology with conventional energy systems, Annual Review of Energy, vol. 4, 1979, pp. 313-352.

(iii) Sustainable base-load is small, unless a large, central power plant with a central energy storage is integrated into the system.

60. Again, it is unlikely that a predominantly solar/wind system can be developed in the next 10/15 years. Maximum possible penetration of such systems should be encouraged as part of rural development programmes, but they are unlikely to meet a significant percentage of the identified regional energy needs in the next 10-15 years.

61. Summing up, then, the study of energy supply scenarios, one is brought back to the point from which one started: the "surprise free" scenario, with conscious "trimming of sails" to include both large hydro/nuclear and rural solar/wind components is likely to be the possible course of energy development for the oil-importing developing ESCAP countries. The process is not unmanageable, but it requires a concerted effort on several fronts.

IV. POLICY RECOMMENDATIONS FOR THE ENERGY TRANSITION ERA IN ESCAP

62. The rudiments of a coherent regional strategy for managing the energy transition process in the ESCAP region over the next 10-15 years emerge from the above analysis.

63. With likely demand growth prospects based on expected structural changes and high growth in the region, the energy transition may just be manageable if all the measures identified here are implemented via a concerted regional effort.

64. Major components of a strategy include:

(a) A coal-based economy (to replace the expected increase in import requirements) based on indigenous and regional (Australian) coal;

(b) The replacement of a possible shortfall in indigenous oil production by imported LNG and/or methanol wherever feasible;

(c) A gradual transition from an "imported methanol" - based energy economy to an indigenous, renewable, biomass derived methanol economy;

(d) Rural developments of solar, wind, minihydro energy sources.

Financial impacts

65. While the total capital requirements of an energy programme for oil-importing ESCAP developing countries are likely to be considerable (the $US 36 billion to 81 billion required until 1985 and 1995, cumulatively, for power generation could serve as a rough "rule of thumb" estimate) what the concern

here is with marginal or additional capital requirements to manage the "energy transition", assuming "main stream" requirements for energy development already committed.

66. The argument has been made that while in an assumed high growth region (based on the World Bank scenario) domestic capital formation may be able to cater for the "base load" requirements, the transition requirements (as identified above) will have to be covered by outside finance capital. Such capital may become available.

67. Reasons for this optimistic contention are twofold:

(a) The region will continue to represent an attractive area for finance capital, due to its growth prospects;

(b) Large energy projects are likely to be profitable, thus attractive to outside financial interests (especially those from the Middle East since they are in the energy business, and thus are likely to want to invest surplus funds in a high return business which they already know!).

68. The "transition" requirements in LNG (or methanol) investments have been estimated as of the order of $US 10 billion.

69. It is too early to estimate coal-related investments, pending the outcome of a coal logistics and beneficiation study. These are, however, likely to be at the utilization side, where they would be part of planned industrial development (e.g. chemical industry, car industry possibly based on methanol engines etc.) thus the marginal or extra investment necessary for the coal chain are likely to be in the shipping and port development area only. The export side is being developed by Australia as part of existing plans, so it is not considered to be part of the marginal capital requirements. Roughly, then, the investment could be considered to consist of two or three large coal ports, 50-60 large coal carriers (at the 100 million ton/year Australian export level) and a number of small self-unloading "transshipment" carriers (or barges). The coal-fleet (based on all newly-built ships) would be some $US 2-4 billion, while a similar amount could be considered necessary for port developments. Here, international lending agencies could help.

70. Again, it is too early to estimate capital cost requirements of biomass-based methanol (pending a current ESCAP study into the subject), but as an order of magnitude estimate something similar to LNG/methanol developments

/might be

might be required. The distribution system, however, would have already been developed for the former, import-based methanol energy economies. Again, international private capital might be available for these projects (as a continuation of the already established methanol involvement of Middle Eastern capital). Such projects could have some domestic (agricultural) "multiplier-effects".

71. To summarize, the net additional indigenous capital requirement to be provided by taxation and/or aid money for the region (out of the total, say, $US 26 billion over 15 years "transition cost") is likely to be related only to the coal distribution system of, say, $US 4 to 8 billion (ships and ports) while the cost of the transition can otherwise be managed by drawing on international private capital, the more so because the management of some of these projects could involve enhanced international management co-operation. International capital is likely to continue to search for high-return investments in a growing (and stable) area of the world. ESCAP developing countries could benefit from this, as long as they can negotiate favourable contractual terms. It is more difficult to find outside capital for rural energy, except if components of the equipment used could be mass-produced. Negotiation support could be provided by ESCAP.

Supply security impact

72. Since the region is likely to be able (almost) to preserve self-sufficiency via the "transition" as described above (the exception being the Middle East-based LNG or methanol projects which, however, by their nature, ensure long term supply security contractually one can look forward with some hope to "managing the transition" if action is taken early and decisively.

Growth impact

73. The transition programme, as designed, has taken into account the additional energy requirements of a high regional growth strategy. In addition, the energy-related capital investments from the Middle East can have additional multiplier effects (especially those related to, for instance, biomass for methanol) and thus further enhance growth prospects of the region.

Consumer satisfaction impact

74. While in other regions of the world energy saving is the order of the day, even at the cost of consumer satisfaction, an explicit formulation of energy availability for satisfying productive consumers in a growing economy can rightly be chosen as ESCAP's strategy objective. Thus, electrification at a large-scale, possibly methanol-driven""diesel" vehicles for heavy equipment, etc. should be considered as parts of the economic "basket of goods" ESCAP countries may deliver to their consumers while, at the same time, using energy as efficiently as possible, without sacrificing comfort and productivity.

75. A suggested summary of ESCAP-sponsored studies to facilitate the above energy transition programme includes:

(a) Study on coal logistics in the ESCAP region;

(b) Study on the beneficiation of coal through the "coal centre" ("coal-plex") concept;

(c) Ethanol/methanol/methane from biomass;

(d) A study tour of existing LNG/LPG/methanol projects;

(e) Modelling long-term energy scenarios for the ESCAP region;

(f) Project to develop mass-produced solar/wind components.

While (a) and (c) are already in the work programme of ESCAP, approval of for the other four projects is sought from the Committee.

76. In addition, (since there is no central energy organization in existence for the ESCAP region), it is suggested that the secretariat could fulfil this role and act as a co-ordinating body for regional energy programmes. Thus it is suggested that an executive organization be organized within ESCAP with its own budgetary resources for:

(a) Exploration programmes;
(b) Contracting support programmes;
(c) Industrial development/prototype system programmes;
(d) Information exchange programmes;
(e) Emergency oil sharing administrative programmes.

77. The core of such an organization could be established as the steering committee and secretariat of the UNDP-sponsored Regional Energy Programme and Pacific Islands Countries Energy Programme to be established early in 1982.

V. IMPLEMENTATION AND ORGANIZATIONAL REQUIREMENTS

78. The experience of conservation and interfuel substitution in developing countries, especially that of India, in the past decade or so has suggested that the success of various policy instruments depends, to a large extent, on the organizational support that is provided for policy implementation. As was discussed earlier, the extent of oil conservation achieved depends on the actions of a large number of consumers: households, entrepreneurs, managers, transport operators and government officials. These consumers respond differently to different signals and react in a variety of ways, usually unknown. The consumer is to be made aware of the existence and financial viability of a variety of measures/technologies for fuel conservation. He has to be convinced that these measures are, in fact, effective and these technologies would work. He has to be shown that such modifications can be done at appointed places and that new technologies can be installed at the estimated costs. He has to be assured that after-sale maintenance and repair service is available within his reach and necessary spares and parts of required quality are in fact available in the market. Even when he is convinced of the technical and financial viability of the measure/technology involved, he has to be provided with an incentive to adopt that measure. Besides this incentive in terms of some form of subsidy or tax concession, it may become necessary to make provisions for financial assistance. All these serivces would require a well co-ordinated organizational set-up which could provide the necessary technical and financial inputs to the consumers. The whole thing would have to be evolved as an oil conservation policy package available within easy reach of a variety of consuming units. This package would consist of (a) availability and knowledge of technological choices, (b) economic evaluation of technical alternatives, (c) financial viability and motivation, and (d) organization and management. Efforts would be required simultaneously on all these four aspects if significant results in oil conservation are to be achieved.

Availability and knowledge of technological choices

79. One of the most important conditions for a successful implementation of the programme is knowledge and availability of various fuel-efficiency measures and new technologies. This knowledge and availability has to be very specific, e.g. a specific process for better utilization of steam or

/process

process heat or availability of a solar system for industrial process heat or a biogas plant. It is not sufficient to know that these technologies exist; it is important to convey the fact that such technologies/units can be installed if so desired by an entrepreneur/farmer.

80. The information on each process/technology should be complete giving data on technical, economic and financial aspects; listing maintenance and special input requirements as well as giving details of agencies who have the experience to install and maintain the related equipment.

81. Invariably, the information on processes and technologies is rather vague, especially in the case of renewable energy technologies. There may be a number of references on the potential of small-scale gasifiers in irrigation pumping, but it may be difficult to find a supplier for these gasifiers or to find a person who has used one on his farm.

82. Similarly, some of the technologies may be available at the research and development stage and may need scaling up. In the case of others some experiments in research institutions might have been carried out. It is important to list the status of each of the available, existing or potential, technologies along with its capital costs, operating costs and operating requirements. The results of the field experiments, if any, should also be made available for each technology. A detailed review of the problems of adoption of each technology in the field should also be made so that necessary technical improvements in the design, materials, related equipment and maintenance requirements can be done.

83. No technology should be considered as available unless a thorough socio-economic analysis of its success and failure in the field has been done. Putting a technology on the "available list" without proper techno-economic-social-environmental appraisal gives a bad name to the technology and biases potential consumers against its adoption.

84. For example, in India, biogas technology has been adopted as a viable renewable energy source and has been promoted through subsidies (ranging between 25 per cent and 50 per cent of capital cost) and soft loans. However, the biogas programme could be called a failure since not more than 75,000 plants could be installed during a 20-year period against a potential of more than 12 million family size units.[9/] This is primarily because the technology

/was

9/ This figure is based on estimates given by K. Parikh. The Government of India has a plan of establishing 1 million family-size units during 1981-1986.

was made available to the public without solving the problems of high capital cost, low gas output in winter, inadequate availability of inputs and problems of maintenance/repairs. Further, no sustained co-ordinated organization effort accompanied the popularization of the technology, the result of which is that farmers are quite sceptical about the technical and financial viability of family units.

85. From this example it is clear that it is necessary to publish a well-reviewed record of performance of different technologies, processes and improvements so that consumers can see what technological choices are available to them.

Economic evaluation of technical alternatives

86. In addition to the listing of available technologies/processes, it is important to carry out detailed economic evaluation of available technical alternatives from the societal point of view. It is necessary to rank each of the available alternatives using the framework of social benefit cost analysis (SBCA).[10/] This requires that for each scheme/process/technology, a detailed quantification and valuation of direct as well as indirect benefits and costs should be done. Care should be taken to quantify the savings in oil consumption as well as the requirements of capital, foreign exchange, scarce raw materials/inputs, skilled labour and management. The SBCA technique can also be used to reflect objectives of development such as employment creation, income distribution, regional development and meeting basic human needs. Environmental impacts, including health benefits and costs, of each technology/process can also be reflected in SBCA. A complete analysis would require the use of shadow prices for valuation of inputs and outputs and put explicit weights on other objectives.

87. It is necessary that the results of such analyses should be published for each technology/policy so that its economic desirability for the country can be assessed. The technology should be made available to consumers -- only after such economic desirability from the societal point of view has been established beyond doubt. In the interim period efforts should be concentrated on technical improvements and their field testing. It is advisable to focus the research work to perfect a technology so that its failures in the field can be minimized.

/Financial

10/ The SBCA technique is wellknown and has been used in evaluation of renewable energy technologies.

Financial viability and motivation

88. Even if a technology/process is economically desirable from the societal point of view, it is necessary that it should also be a financially viable proposition. Hence, a cost-benefit analysis would also be required from the point of view of the user. This result may not coincide with the result of SBCA because market prices may deviate from shadow prices owing to the presence of price controls, taxes, subsidies etc.

89. In the case of a divergence in the recommendations about a technology/process, it may be necessary to suggest use of tax/subsidy mechanism to bring the financial viability in line with economic desirability. For example, if biogas used for lighting and irrigation is considered socially profitable at the current and projected shadow prices of diesel and kerosene, then this fact should be reflected in the private profitability of biogas units. For socio-political reasons, it may be considered desirable to keep kerosene prices low through subsidies and also keep diesel prices low to avoid diversion of kerosene to diesel by consumers. Under these circumstances, a consumer who faces low kerosene and diesel prices is going to calculate his savings of kerosene/diesel at market prices and, hence, would find their substitution by biogas relatively less profitable than is the case when shadow prices are used. Thus, it may become necessary to provide an outright subsidy on capital cost and/or provide subsidized capital (as soft loans) so that private profitability moves in the direction of social profitability. Unless this is done, there is no motivation for the farmer to install a biogas plant.

90. Similar examples can be given in the application of solar energy for process heat in industrial units or shift of goods from road to railways to save diesel or improvement in the efficiency of kerosene stoves.

91. Given the subsidized price of an oil product, its substitution by another fuel or by capital (or skilled labour) is not likely to be financially profitable unless similar subsidies are also provided for the substitutes through lower prices, lower interest rates, tax concessions etc. Thus, the process of determination of relative prices for various energy products also involves a corresponding set of decisions on tax/subsidies mechanisms so that desirable forms of substitutions are encouraged.

92. It is necessary to recognize that consumers' decisions would be motivated by their private profitability calculations and their view of returns

/from

from alternative uses of their scarce funds or manpower resources. Given the inherent uncertainties in the use of new processes or renewable energy technologies, an entrepreneur is understandably reluctant to commit scarce resources without substantial tax incentives/subsidies. However, availability of these tax incentives and/or other subsidies would be only a necessary condition for the motivation of the entrepreneur/consumer and not a sufficient condition to induce investments. His decision would be crucially dependent on his views regarding the availability of technology/process, uncertainties in operation, problems of maintenance and spares and his confidence in the organizations who are sponsoring the technology/process.

Organizational and management requirements

93. As was discussed in earlier sections, technical knowledge, economic evaluation and financial viability are only the first steps in a programme of energy transition. Successful implementation would depend on the organization which is set up to deliver these technologies/processes to the satisfaction of the consumers. No amount of education, persuasion, tax incentives or subsidies would be of any use unless the consumers are convinced that the alternative technologies/processes are available and are likely to deliver the goods.

94. A general lack of confidence may be found in the users if the programmes are sponsored by the Government because of their experience of earlier such programmes. In some cases (e.g. biogas) government programmes may be viewed as schemes to benefit the richer sections of the society and, hence, people may not like to participate in such schemes. It is absolutely necessary to gain the confidence of the users through field trials to demonstrate the technical feasibility and financial viability of the project along with the presence of an efficient back-up organization.

95. It may be necessary to set up organizations at various levels: at the central government level and at regional centres; at village level and at the level of a cluster of villages (e.g. a block). The organizational set-up would require co-ordination of a large number of agencies at various levels. For example, a successful biogas programme would require a central agency which co-ordinates the work of different research institutions engaged in improving the technical characteristics and reducing the costs of a unit. This central agency would also sponsor or conduct studies on economic profitability

/and

and financial viability of biogas units for various categories of farmers in different regions. This agency would publish these data with a critical review of the working of biogas units in the country. It will also advise the Government on the extent and nature of subsidies or tax concessions to be given. This central agency would also have to co-ordinate the activities of the following agencies at the central, regional or village levels:

(a) Technical agencies which advise and educate the farmers and provide technical knowledge and support;

(b) Production agencies such as agro-industrial corporations or fabricators involved in production of gas holders, burners, lamps, dual-fuel engines which run on gas and diesel, electricity generators, distribution pipes etc;

(c) Trade organizations which are responsible for delivery of raw materials (e.g., steel) to production agencies and to farmers (e.g., cement) and other equipment;

(d) Financial agencies who process the applications for subsidies and subsidized loan etc.;

(e) Service organizations which have technical expertise to repair and maintain biogas units, generators, dual-fuel engines and burners/lamps;

(f) Administrative and executing agencies of the government or voluntary organizations who are responsible for the delivery of the new technology in the field.

96. The experience in India shows that the biogas programme has not made a significant impact on the energy scene because of the lack of co-ordination among different agencies.

97. Similar organization charts can be drawn for various technologies/ processes. Not every technology may require elaborate organization in every region and a given agency can meet the needs of a number of technologies. It is important to recognize that systems which require the co-operation of villagers have significant political and social implications and any organizational set-up should explicitly recognize these constraints.

98. The organizational structure suitable for a country would depend on its size and the role of the Government in over-all economic activity. In a

small country one central organization with one or two regional centres may be sufficient to manage the complex techno-economic-social tasks. However, in a large country, there may be a need for a number of regional centres at different levels (State/province, district or block) alongwith a central organization. In a country where government does not play a dominant role in investment and production activities, it may be possible for the oil conservation organization to resort to indicative planning along with suitable modifications to relative prices of energy and non-energy inputs. However, such an organization may have to play an active role in a country where the Government has control over imports, production activities, investment, supply of raw materials and location of industries. Under such circumstances, co-ordination of a large number of government departments and agencies would become a necessary condition for successful implementation of oil conservation programmes.

99. On account of significant differences among ESCAP countries in regard to size and role of government, it is difficult to suggest a representative organizational structure. However, a prototype organizational set up is attempted below in order to bring out the salient features which are considered important for successful implementation of programmes/schemes. This has to be taken only as a suggestion and should not be considered as a recommended organizational chart.

Organization at the central level

100. The set-up outlined in figures 1 and 2 gives the type of structure which would be required for a large country with substantial control by the Government in initiating and implementing programmes of oil conservation/substitution. For the sake of convenience, this set-up is called the Oil Conservation Commission. At the apex of such an organization at the central level would be the chief executive (prime minister or president) of the country or the minister/executive in charge of the energy portfolio. It is important to have the highest executive as its head because of the significance attached to the programmes of oil conservation as well as the need for getting utmost co-operation from other ministries/departments and regional centres. The interest of the highest executive would ensure that usual delays on account of lack of co-ordination among participating agencies do not hinder the progress of work.

/Figure 1.

Figure 1. Oil conservation commission: central organization set-up

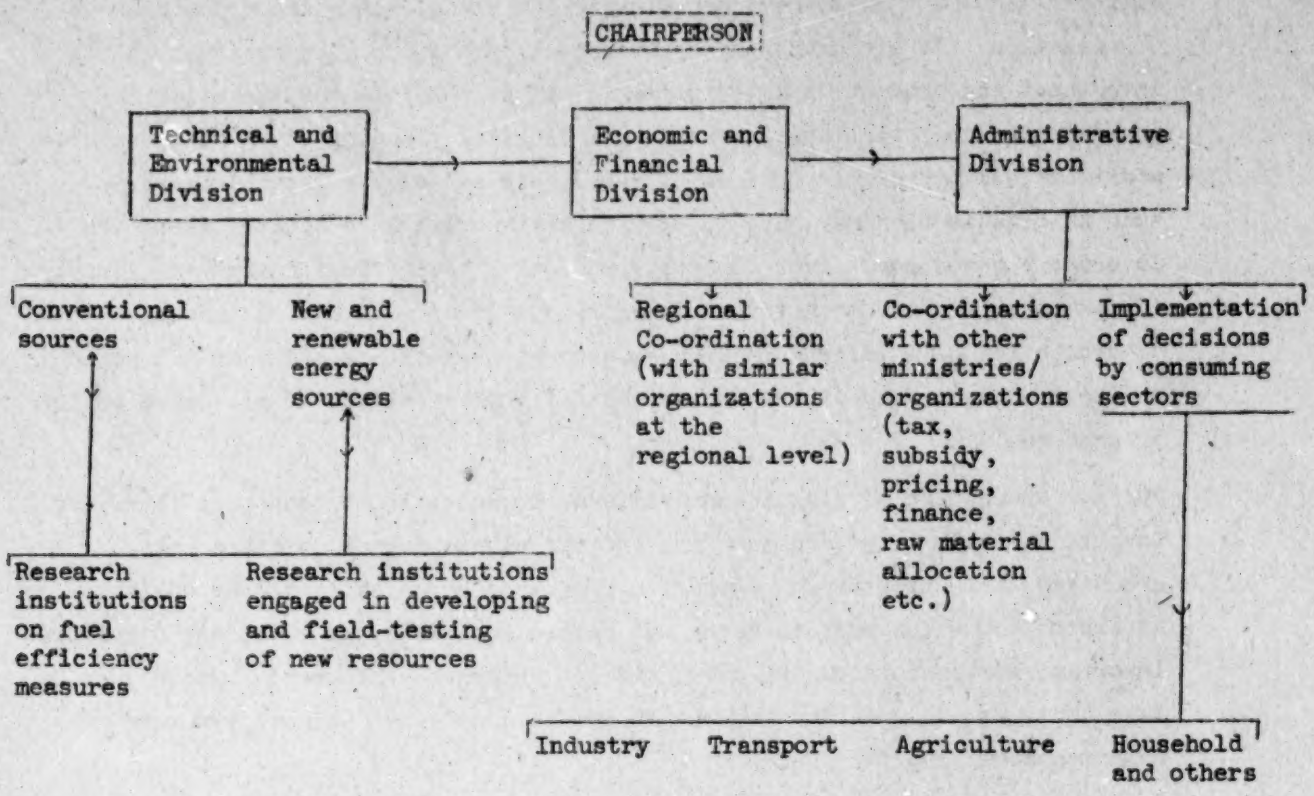
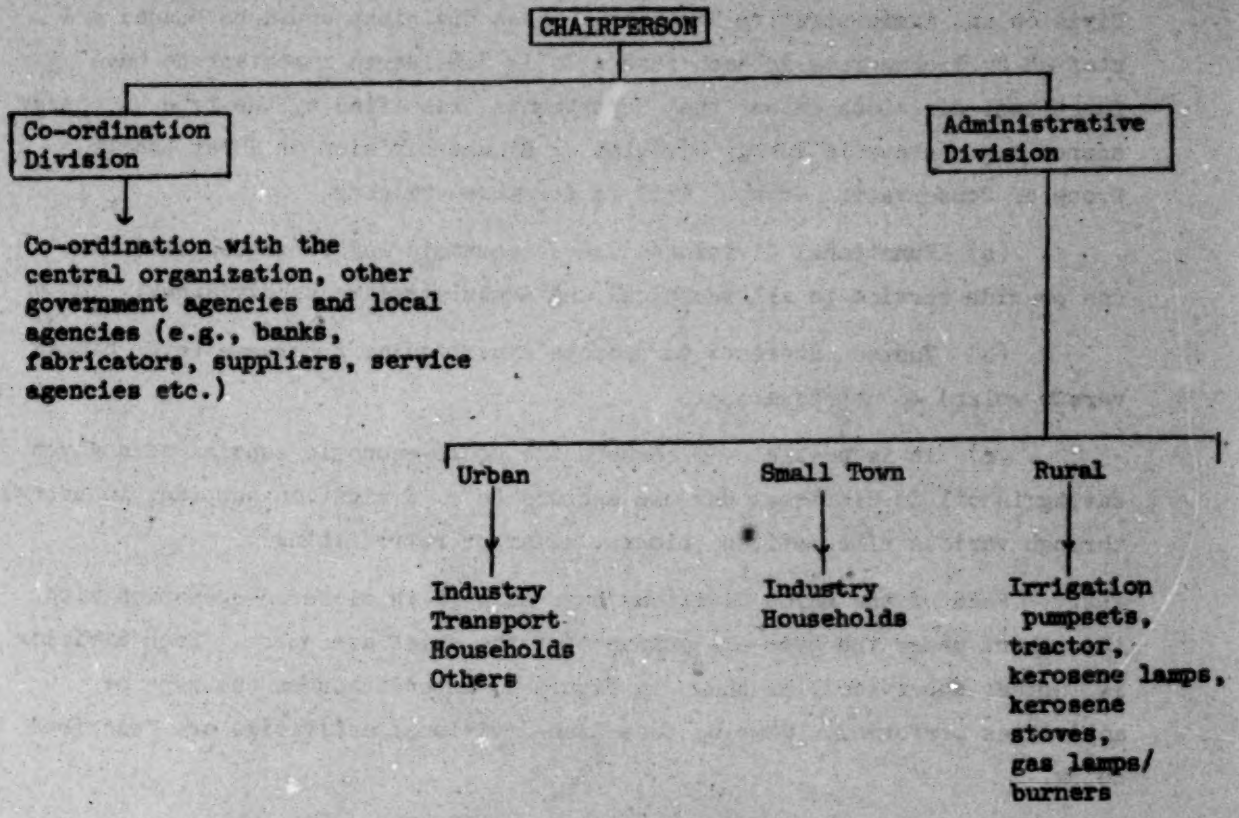

CHAIRPERSON
Technical and Environmental Division
Economic and Financial Division
Administrative Division
Conventional sources
New and renewable energy sources
Regional Co-ordination (with similar organizations at the regional level)
Co-ordination with other ministries/ organizations (tax, subsidy, pricing, finance, raw material allocation etc.)
Implementation of decisions by consuming sectors
Research institutions on fuel efficiency measures
Research institutions engaged in developing and field-testing of new resources
Industry
Transport
Agriculture
Household and others

Figure 2. Oil conservation commission: regional level set-up



101. As shown in figure 1, the organization is divided into three functional divisions: Technical and Environmental Division; Economic and Financial Division and Administrative Division. These divisions would be headed and staffed by technocrats in each case. It is considered important to have functional divisions rather than departments classified by the type of energy source e.g. Renewable Energy Division or Biogas Division or Solar Energy Group or Conservation Group. This is for three reasons:

(a) Functional divisions such as economic and financial divisions can provide service to all technical and administrative subdivisions;

(b) Vested interests to promote a particular programme (e.g. biogas versus solar) do not develop;

(c) It is possible to compare the socio-economic aspects of a given saving in oil in different end-use sectors (e.g. irrigation pumping, industry) through various alternatives (biogas, solar or retrofitting).

102. Each of the major divisions have to work in close co-operation with the others under the over-all guidance of the chief executive. Each division is further subdivided, as shown in figure 1, depending upon the type of activities performed. Some of these sub-divisional activities are described below.

103. The Technical and Environment Division would be responsible for co-ordinating the activities of various research institutions, universities, research and development centre in private industry and foreign collaboration. For the sake of convenience, there may be two or more subdivisions such as those relating to conventional sources, renewable energy sources etc. This division would undertake funding, co-ordination and review of available technologies in the country and abroad and would also finance field-testing of different equipment or processes. Regular reports of various technical alternatives would be made to the economic and financial division for further evaluation and analysis. Based on these reviews, the technical division would sponsor research on critical areas or components where cost reduction and/or improved performance are required. Thus, there would be a continuous interaction and dialogue on the techno-economic-social and environmental aspects of each of the new technologies or programmes under consideration.

/104.

104. The activities of the Economic and Financial Division would include:

(a) Social-benefit cost analysis of a given technology or technical improvement or process improvement as outlined above;

(b) Financial viability calculations of the above alternative at the given market prices for oil products, capital, scarce raw materials and skilled labour;

(c) Suggest eccnomic and financial measures which would motivate private entrepreneurs/consumers to opt for socially desirable investments;

(d) More specifically, suggest changes in prices, excise duties, tax - concessions or rebates, provision of soft loans etc. which would encourage desirable forms of substitution;

(e) Conduct and sponsor elaborate studies on the impact of higher oil prices on inflation, price and income elasticities of demand for oil products in various end-uses and estimation of elasticities of interfuel and interfactor substitution in consuming sectors;

(f) Conduct and sponsor field surveys and research on the impact of price changes and non-price instruments on the behaviour of consumers regarding conservation/substitution;

(g) Organizing education, information and demonstration on such issues as why the efficient use of energy was important, how energy could be saved and how far energy-conservation technology or renewable sources had been developed;

(h) Establishment of a data centre giving reliable data on the demand and supply of energy, preferably in a format which allowed easy comparison with data from other regions/countries.

105. The Administrative Division would be responsible for general implementation of decisions for various consuming sectors, co-ordination with other government organizations/ministries at the centre and co-ordination with other regional centres. Its main activity would be to "deliver" the actual services to the consumers, i.e. provide consulting services, management services and after-sale services. This division would have staff who could undertake

studies on fuel-efficiency measures, would provide a package of instruments and equipment as well as installation and maintenance services. In a way, this division should be able to provide the full services on a "turn-key" basis so that entrepreneurs do not have to go from one organization to other in search of competent professionals. It is only when this "package approach" is adopted that the confidence of the consumers in the workability and viability of these technical alternatives would grow over time. Once these services are tested and found efficient, the programme would be successful, resulting in significant savings in oil consumption.

106. The Administrative Division would provide services organized by the consuming sector rather than by a particular energy source or process. For example, if an industrial unit wants to conserve oil, it could improve its boiler/furnace and/or shift to a coal-firing boiler or use solar industrial process heat system. The relative economics of each of these alternatives should be examined and the best solution/service offered. Or, for irrigation pumping in a district, oil consumption could be reduced by adopting a judicious mix of available sources: electricity, biogas, photovoltaics, solar pumps etc. It would not be correct to recommend either biogas or solar energy as the exclusive alternative. Hence best results would be achieved if the services are provided on the basis of end-use and the optimum mix of energy sources suggested after doing detailed social-benefit analyses and private profitability calculations. Needless to add that the efficiency of the delivery system would determine the success of the programmes.

Organization at the State/regional level

107. As outlined in figure 2, the regional-level organization would have a Co-ordination Division and an Administrative Division. At the regional level, mainly administrative agencies would be set up which would provide help in implementation of various schemes of retrofitting or fuel substitution. These would also be organized by end-use sectors

/so that

so that all the relevant options are examined in a particular context. As the nature of services required would be different in industrial towns as against villages, the sub-regional groups may be made available at each level: city, small town and village or cluster of villages. The type of services to be provided would include: fuel efficiency services for small industries, brick kilns, sugar mills etc.; improvements in existing electric motors and diesel engines used for irrigation; installation of biogas units and dual-fuel engines for irrigation and other motive power; supply of equipment/spares for improved kerosene lamps, stoves, biogas burners, gas lamps etc. All these services would require an efficient organization with skilled workers equipped with necessary instruments. It would also require support of the local administrative and political organization so that their efforts receive necessary co-operation from the people. The regional-level organizations would have to keep in close touch with the central organization to receive up-to-date information from above as well as to provide a progress report of field activities.

108. As was discussed earlier, the above ideas are rather preliminary in nature and have been presented to accord due importance to the organizational aspects. The available experience shows that lack of a well thought out organizational set-up has been responsible for slow progress in oil conservation and adoption of renewable energy sources in developing countries. The organizational structure most suited to each individual country would have to be evolved by keeping in mind a variety of political and economic factors. A beginning may, however, be made to conduct a comparative study of different organizational structures in a few selected ESCAP countries.

VI. TOWARDS AN ESCAP ENERGY ORGANIZATION

109. During the past several years - starting in 1964 and with more and more impetus after the 1973 oil crisis - it has been proposed that the ESCAP region should have a regional organization concerned with energy matters. This proposal were again at the Tokyo high-level meeting of energy ministers organized in July 1981 and for that reason a study is undertaken below of the purpose and objectives such an organization might serve and how it might achieve those objectives.

110. Why has a need arisen for a regional energy organization? It appears that energy problems often transcend national boundaries. Internationally traded energy in the form of oil and to a lesser extent but with increasing importance gas, coal, uranium etc. represent a lasting component of most country's energy balance, thus a regional organization facilitating such trade on the one hand, and assuring orderly and reliable supplies on the other, will have a role to play even in normal times. This role is even more important in times of possible crisis, when limited supplies have to be shared equitably among all the participants. Long-range development of energy supplies have also to be co-ordinated since these involve the mobilization of substantial technical and financial resources, often beyond the capabilities of any single country. Finally, since energy industries (e.g. oil, gas, coal, uranium) are often organized in a transnational framework by transnational corporations, it might be useful for countries to harmonize policies in achieving most favourable terms and more reliable service from such transnational entities in the field of energy development and trade. Before recommending an organizational structure for the ESCAP region, let us first review the structure of similar organizations: the International Energy Agency (IEA) and the Latin American Energy Organization (OLADE).

Examples of existing energy organizations

The International Energy Agency (IEA)

111. IEA is an international organization composed of 21 industrialized countries in Europe, North America and the Pacific area. It was created in 1974 to administer the International Energy Programme (IEP). IEP contains a broad set of measures for resolving the energy problems which had been made manifest during the previous year or so. They include:

(a) A system for sharing available oil in a supply emergency;

(b) Addressing the medium-term problem of meeting growing energy needs against a background of limited oil availability in the future;

/(c)

(c) Providing a research and development programme as a basis for meeting longer term energy needs;

(d) Improving relations with other oil-producing and oil-consuming countries.

112. The central objective, tying all these elements together, was to prevent difficulties of energy supply from creating severe economic problems and thereby affecting the political relationships among member countries.

113. IEA is thus seen as basically a "defensive" organization, born out of a perceived threat to energy supply security. Its organizational structure reflects this: there are task-oriented standing groups which deal with practical measures to be taken to combat the perceived threat to supply security, reporting to a Management Committee, supervised by a ministerial level Governing Board, served by a Secretariat.

113. The four Standing Groups are:

(a) Standing Group on Emergency Questions;
(b) Standing Group on the Oil Market;
(c) Standing Group on Long-Term Co-operation;
(d) Standing Group on Relations with Producer and Other Consumer Countries.

114. The key to the effective operation of IEA is the work of the Standing Group on the Oil Market, empowered to have access to oil company information, thus establishing an information system on the international oil market. In case of an emergency, the Standing Group on Emergency Questions will activite the previously agreed oil-sharing mechanism, making use of the oil market information, with the help of an international advisory board from the oil industry.

115. While the emphasis of IEA has historically been in establishing an effective emergency oil-sharing programme via the above two Standing Groups, the framework of long-term management of an energy transition process is also established via the remaining two Groups.

116. The Standing Group on Long-Term Co-operation has the explicit task of promoting conservation measures on the one hand and of developing alternative sources of energy on the other, iva various measures including jointly financed projects. Research about the following subject matters is explicitly specified: coal technology; solar energy; radioactive waste management; controlled thermonuclear fusion; production of hydrogen from water; nuclear safety; waste heat utilization; conservation of energy; municipal and industrial waste utilization for energy conservation; and over-all energy system analysis and general studies;

/117.

117. Uranium enrichment is a specific concern, where, again, possible jointly financed projects might be organized. Co-operation on a broader framework might be initiated by the Governing Board.

118. Finally, the Standing Group on Relations with Producer and Other Consumer Countries has the task of smoothing any possible conflicts of interest with other countries, having such tasks as, for instance, promoting industrialization in the oil-producing countries, and to "give full consideration to the needs and interests of other oil consuming countries, particularly those of the developing countries". Thus, in effect, the Group is the diplomatic arm of IEA.

119. Membership of IEA is open to OECD member States, upon acceptance by the Governing Board, in majority. Unanimity by the Board is required for modifying the Charter Agreement. Any other issue is decided by a complex set of voting procedures, where each country has so-called "general voting rights" (three each) and also "oil consumption voting weights" based upon their percentage of oil consumption as incorporated in the charter. "Combined voting rights", adding the points of "general voting rights" to the percentage points of "oil consumption voting weights" are also used for certain "special majority" decisions, as laid down in the Charter.

120. Since the operation of the Agreement hinges on participating countries complying with the 90-day "emergency storage" provision of the Charter, it is of considerable importance how the technical issues of measuring such storage (and/or substitute stand-by production capacity) are resolved. In this context it is of interest to note that stocks held in: pipelines, rail tank cars, truck tank cars, ship's bunkers, service stations/stores, only consumers and tankers at sea as military stocks are not included in the emergency 90-day reserves, giving, so to speak, an additional "cushion" in case of emergency.

121. Fuel switching capacity, i.e. bringing into the system substitute fuels "may be credited towards emergency reserve commitments insofar as they can be used during the period of self-sufficiency". Some of the conditions are that these are under the Governments' control and can be activated within a month as "secure supplies of alternative fuel".

122. Via special agreements, standby capacity and stocks in another country may be credited towards emergency reserve commitments, provided transferability is guaranteed by such agreements.

/123.

123. These measurement questions, although they may appear to be academic, do have considerable importance, since emergency alloctions depend on measurements of stocks available. Thus, the perceived fairness of the whole system (and, thus, its continued legitimacy and existence) depend on how well these questions of measurement are resolved.

124. The system for emergency oil sharing was tested for the third time in October and November 1980, via a "dry run". It was found that the data needed could be transmitted and processed, the calculations for allocating supplies could be done in a timely fashion and international supply patterns could be re-arranged so that each country within IEA received its fair share of oil. Allocations can be reviewed on a monthly basis. National measures consistent with the programme could also be handled in a timely fashion. This third Allocation System Test was considered by IEA to be a major success, especially since it took place during an actual supply disruption caused by the hostilities between Iran and Iraq.

125. The Test had the characteristics of a "mobilization effort", as all 21 member countries set up crisis organizations and some 45 reporting companies participated directly in the Test.

126. What would have been interesting to include---but could only be done in a real emergency---is to monitor the non-IEA countries' reaction to IEA measures. Such impact will not manifest itself during a test but will surface in a real emergency, necessitating, perhaps, co-operation on a wider basis than IEA alone.

The Latin American Energy Agency (OLADE)

127. While IEA has been organized as a response to the threat of oil shortages, and its secondary activities in managing the long-term energy transition have developed only as important but subsidiary concerns, the Latin American Energy Organization has from its very inception concentrated on managing the supply transition process, both via the encouragement of conventional energy developments and also via its activities in the field of geothermal, power alcohol, biogas, mini-hydro and other project developments.

128. OLADE is similar to IEA in its ability to manage jointly financed projects, having direct budgetary control over exploration activities and also some pilot projects in energy development.

129. OLADE works with a top professional "core group" of about 35 persons at its secretariat, having attracted the highest calibre talent in each of its main areas of interest. In addition, for special projects, it hires consultants.

/Similarly

Similarly to IEA, the Secretariat's Executive Secretary reports directly to the ministerial level Board. There is no "middle tier" of management committee, the Executive Secretary has a direct mandate and also the necessary staff to implement Board resolutions. It is, thus, a less complicated organization, with quite a wide scope for effective action in the field of new and renewable sources of energy and energy planning. Since its main concern was not emergency oil sharing, the cumbersome machinery and organization to implement such emergency mobilization programmes was not needed for OLADE.

130. Some of OLADE's programmes and working methods can be described as follows:

(a) Area I: Analysis, prospectives and energy planning

Objective:

To provide member nations with the tools necessary to their energy planning, helping to make decisions on matters related to energy policy.

Programme:

The establishment of inventories of the region's energy resources and methodologies for the construction and unification of regional energy balance and models for understanding of supply and demand of energy in Latin America. To define policies of rational use of energy.

(b) Area II: Development of technical projects and technology transfer

Objective:

To encourage, co-ordinate and offer help in projects for the exploration and exploitation of member nation's energy resources, in order to increase supply and diversify energy sources.

Programmes:

1. The establishment of the phase of exploitation and development of geothermal exploration methodology as well as the production of bio-gas and small hydro-electric plants;

2. The diagnosis of the regional oil and carbon situation in Latin America. To offer aid and counsel on matters related to contracts for oil exploration in Member Nations and to organize technical courses in geothermics and biogas;

3. The establishment of technical projects and technology transfer systems for geothermics, biogas, small hydro-electric plants and eolithics.

/(c)

(c) Area III: Commercialization industrialization and capital assets

Objective:

To propose and stimulate actions for commercializing energy systems and for developing capital assets for energy in the region.

Programme:

To diagnose supply and demand for finance capital in the region.

(d) Area IV: Systems for financing energy programmes

Objective:

To obtain financial and technological resources from inside and outside the area in order to promote energy projects in the region.

Programme:

To finance development projects from extra-budgetary funds.

(e) Area V: Training courses

Objective:

To build up the number of experts and technicians.

Programme:

Training courses and scholarship programme for experts and technicians.

Alternatives for an ESCAP energy organization

Features of a minimal organization

131. There are essentially two objectives a regional energy organization might have identified in the Introduction. The first of these is to handle emergencies in energy supply and the second to facilitate the current energy transition from a largely oil-based energy economy to a more diverse supply mix in the medium and longer term.

As regards the first of them, some developed ESCAP countries (e.g. Japan, New Zealand) are members of IEA and thus their emergency needs may already have been taken care of. ESCAP has as members a number of oil-exporting countries (e.g. Brunei, China, Indonesia, Iran, Malaysia) and, as an aggregate, is self-sufficient in commercial energy. Thus, a minimal organization for emergency measures need only consist of a number of emergency oil supply agreements between

/oil-

oil-exporting ESCAP countries and developing oil-importing countries, without the need for elaborate monitoring and allocating activities devised by IEA.

132. An organization is nevertheless, necessary, especially at ministerial or governing board level, to achieve agreement on these supply arrangement prior to the occurrence of possible emergencies, and to achieve some multilateral "streamlining" of the basically bilateral supply contracts. It is thus suggested that ESCAP convene such a ministerial meeting after the meeting on legislative measures to ensure conservation, already in the work programme. The governing board would be responsible for declaring an "emergency". The bilateral contracts however might have provisions also for "normal supply" periods.

133. The need for, and already achieved penetration of new and renewable sources of energy---as well as the future penetration of various sources of such energy--- is quite different in different ESCAP countries. As a mechanism of information exchange and co-ordination, the energy board might designate the ESCAP secretariat to continue to serve in such a capacity, facilitating information exchange and servicing energy board meetings.

134. The minimal organization thus requires no additional resources, only an agreement on the roles to be played by existing ESCAP bodies in, on the one hand, achieving policy harmonization and, on the other, managing the mechanism of information exchange both in case of emergencies and, also, in the more mundane task of facilitating the energy transition of the region.

A comprehensive organization

135. One might argue that to meet the objectives identified, the above minimal organization might not be enough. Facilitating information exchange, while it is necessary, is not sufficient: a more active promotion of technologies (via demonstration plants etc.) is called for to ensure a more rapid process of energy transition. If this, indeed, is the concensus of ESCAP countries, then an organization similar to OLADE might be established, with a "core" or experts at the secretariat (a minimum "critical mass" of about 35 professionals, as opposed to the current ESCAP involvement of 6 professionals in energy matters and an additional six concerned with energy in various other divisions of the ESCAP secretariat) having the necessary budgetary resources and mandate to pursue a more active programme. In any case, the first step would be the establishment of the energy board (or steering committee) which, then, could decide and legislate upon the instruments necessary both for emergency oil sharing measures and also for managing the energy transitions. These instruments might very well include regional "lead countries" or "demonstrations and training centres" for the various forms of energy (both conventional and new and renewable).

Summary and Recommendations

136. This chapter has been entitled "Towards an ESCAP energy organization". What was intended was not to suggest simplistic formulas but, instead, to suggest a step-by-step process which would establish the kind of organization which could deliver the results expected by the member countries in the process of managing the regional energy transition.

137. The process might very well start with a regional "networking" of energy organizations and ministries, establishing a direct consultative process, not only in emergencies but also in times of normal development when issues of longer-term development can be addressed in a more deliberate fashion. The ESCAP secretariat could service such consultative meetings and, in addition, with the proposed UNDP Regional and Pacific Energy Programmes might work toward a more permanent structure and steering committee for regional energy development activities. The organization should be "lean", not creating more entities than what is required to deliver the results that ESCAP countries expect based on policy analysis and follow-up activities initiated by the rudimentary energy board formed by the network of interested energy ministries. In formulating objectives, organizational tools and methodologies, it is hoped that the experience of other bodies (such as IEA or OLADE) will be of use to the countries.

. . . . .